

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
4 April 2002 (04.04.2002)

PCT

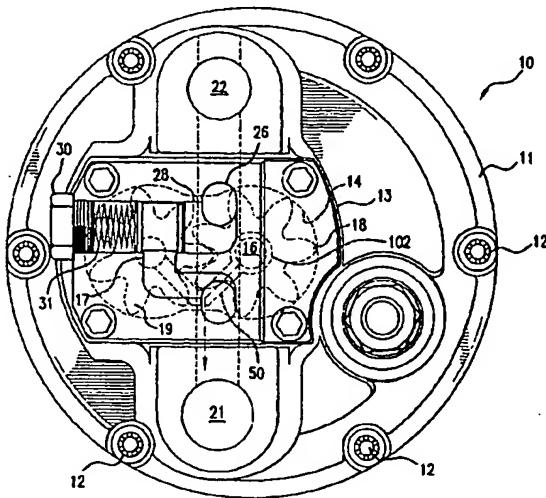
(10) International Publication Number  
**WO 02/27186 A1**

- (51) International Patent Classification<sup>7</sup>: F04B 49/00, F04C 19/00
- (74) Agent: WETTACH, Christine, L.; Cohen & Grigsby, P.C., 11 Stanwix Street, 15th floor, Pittsburgh, PA 15222 (US).
- (21) International Application Number: PCT/US01/30281
- (81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW.
- (22) International Filing Date: 27 September 2001 (27.09.2001)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data: 09/670,706 27 September 2000 (27.09.2000) US
- (71) Applicant: RPM INDUSTRIES, INC. [US/US]; 55 Hickory Street, Washington, PA 15238 (US).
- (72) Inventors: APOSTOLIDES, John, K.; 605 Bending Oak Lane, Pittsburgh, PA 15238 (US). LUSCO, Ronald, S.; 61 Apple Road, Claysville, PA 15323 (US). MCCOSBY, John, J.; 2760 Park Avenue, Washington, PA 15301 (US).
- (84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:  
with international search report  
— with amended claims

[Continued on next page]

(54) Title: IMPROVED ENGINE PRELUBRICATION PUMP ASSEMBLY



(57) Abstract: An engine pre-lubrication pump includes a pump housing (13) with a pump cavity (14) in which a first gear (18) and a second gear (19) are positioned for pumping fluid. The first gear (18) is operably and sealably connected to a motor shaft (16) for rotation and the second gear (19) is rotatably mounted to a second shaft (17) for geared rotation with the first gear (18). Fluid inlet port (21) and outlet port (22) are located in communication with the pump cavity (14) and adapted respectively for connection with a source of fluid and a discharge means and an internal vent 50 is positioned in between the armature shaft (16) or bore and the pump housing (13) along the inlet port (21). Alternatively, a valve means (30) is positioned between the inlet (21) and outlet (22) ports to selectively permit fluid pumped between the inlet (21) and outlet (22) ports to pass through it when the outlet port (22) is flow restricted.

WO 02/27186 A1



*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

**TITLE****IMPROVED ENGINE PRELUBRICATION PUMP ASSEMBLY****FIELD OF THE INVENTION**

The present invention relates to an improved engine prelubrication pump which  
5 operates with an internal combustion engine; and, in particular, to an oil pump which is driven by a starter motor armature drive shaft and which pump includes an internal vent for improved pump and motor durability. The invention is also applicable to stand alone or supplemental prelubrication pumps.

**CROSS REFERENCE**

10 This application is a continuation in part application of U.S. Application Serial No. 08/896,779, filed on July 18, 1997, entitled "Improved Pump Assembly."

**BACKGROUND OF THE INVENTION**

Generally, the fluid pump of the present invention is an improvement over pumps shown U.S. Patent Nos. 4,553,512, 4,875,551 and 4,502,431. These pumps are used to  
15 lubricate the engine prior to the initial phase of the cranking of the starter motor to turn over an engine. Typically, oil is used as a lubricant to allow engine parts to slide freely and easily with reduced friction. Notwithstanding the use of lubricants having high lubricity there continues to be abrasive wear between metal parts in internal engine components such as the turbocharger, camshaft, crank shaft and rocker assembly, for  
20 example. It has been known for some time that the greatest wear on internal engine parts is at the commencement of ignition cranking and engine start-up. During that time, there is insufficient oil pressure in the engine to provide lubrication to the various parts throughout the engine. Accordingly, for these initial moments during start-up, there is metal rubbing against metal without a sufficient lubricant interface so that deterioration in  
25 the internal engine components takes place over time.

A particularly important solution to this problem was provided by a prelubrication system disclosed in U.S. Patent No. 4,502,431 in which oil is introduced in the engine prior to cranking and start-up. The starter motor is utilized as the means for powering the pump to provide prelubrication. In that system, the starter motor armature shaft is  
5 connected to the pump's pumping gears which are rotated to provide the pumping action to the engine to prelubricate prior to the starter motor's solenoid engaging the starter to crank the engine for start-up. One particular embodiment of the starter motor and pump combination is disclosed in U.S. Patent No. 4,553,512 which is incorporated herein by reference.

10 The present invention provides a similar pump assembly as that disclosed in U.S. Patent 4, 553,512 to provide a selectable means for either prelubricating the engine or pumping the oil out for a quick efficient oil change. This is particularly useful to large fleet operators of vehicles which require frequent oil changes.

Accordingly, it is an object of the present invention to provide a pump mechanism  
15 to pump the oil out of an engine sump without having to open the sump's oil plug. It is a further object of the invention to provide a seal bore vent to the pump inlet to minimize the oil pressure at the seal during all modes of operation. It is a further object of the invention to provide a prelube pump having a valve which is selectively operable in the prelubrication mode as well as an oil exchange mode either from the engine compartment  
20 and/or from a time delayed mechanism.

#### SUMMARY OF THE INVENTION

The present invention provides a gear-type pump which is integrated to the starter motor of a vehicle. As disclosed in the aforementioned prior art, the base portion of the pump generally comprises the back or bearing end of the starter motor and includes a  
25 sealed opening through which an extended armature shaft can be mounted to rotate or power the pump gears. A pump housing is integrally formed on the base plate which provides a cavity in which the pump gears are mounted and includes an inlet and outlet port. In addition, the present invention provides a seal bore vent to the pump inlet which uses a passageway from the pump inlet into the armature shaft or pump seal bore to  
30 minimize the oil pressure at the seal during all modes of operation. This vent relieves

pressure from the seal which seals the pump cavity from the motor cavity. In this way, the pump and motor are further protected from damage and their longevity enhanced. This is especially the case when a valve selector and port are provided in the pump as set forth in one of the embodiments hereof.

5        Additionally, the invention may include an additional port for operation of valve mechanism to permit the oil to be pumped and bypassed to the outlet port in normal operation. By rendering the valve "ineffective," oil can be pumped to the outlet port for either prelubrication or for changing the oil of the vehicle.

10      Other advantages of the present invention will become apparent from a perusal of the following description of a presently preferred embodiment taken in connection with the accompanying drawings.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a plan view of the pump of the present invention.

Figure 2 is a side elevation of the pump shown in Figure 1.

15      Figure 3 is a sectional elevation of an embodiment of the present invention.

Figure 4 provides a plan view diagram of a embodiment of the present invention showing oil flow path and pressure relief.

#### PRESENTLY PREFERRED EMBODIMENT

Referring to Figures 1 and 2, pump 10 of the present invention comprises base plate 11 which is adapted to be bolted to the back portion of a starter motor (not shown) by means of a plurality of circumferentially positioned bolts 12. Integrally formed in base plate 11 is pump housing 13 having an elongated pump cavity 14 and central opening through which a motor or armature shaft 16 extends therein. Cavity 14 also includes idler shaft 17 mounted fixably to the other portion of the cavity. Positioned 25 within cavity 14 are pump gears 18 and 19 which are driven by armature shaft 16.

Pump housing 13 also includes inlet port 21 and outlet port 22. These ports are connected to inlet and outlet lines (not shown). Sealingly mounted to the pump housing 13 is sealing plate 23 which seals pump cavity 14 from the outside and shaft seal 101 which seals pump cavity 14 from the motor cavity, as shown in Figure 3.

Pump housing 13 also includes a means to reduce pressure to the seal 101. The means may include, for example, a vent area, channel or hole in the pump or pump housing. In one embodiment, the means includes a Vent 50 from the pump seal bore 102 to the pump inlet 50 which provides a passageway or otherwise connects to and is positioned within pump housing 13 on the side of inlet port 21, as shown in Figure 4. In a preferred embodiment, the vent 50 is a grooved channel connecting with armature shaft 16 or seal bore 102 of pump housing 13 and is positioned in the pump to relieve pressure from seal 101 to prevent damage to the pump and motor. In this way, vent 50 functions to minimize the oil pressure at the seal 101, as well as at seal bore 102, during all modes of operation. Figure 4 also shows a diagram of an embodiment of the present invention of the oil flow path through channel 28 and pressure relief through vent 50 and out suction port 21. In a preferred embodiment, vent 50 provides a self-adjusting restriction on increases to the oil pressure. Vent 50 is also applicable to stand alone or supplemental prelubrication pumps.

In a preferred embodiment sealing plate 23 includes housing 24. In another embodiment housing 24 also has a pair of bypass ports 26 and 27 which are juxtaposed for communication between inlet and outlet ports 21 and 22 respectively. A valve means, such as for example a selector valve 30 comprised of a plug spring 31, and plunger or valvehead, is positioned in channel 28 to provide selectable opening and closing of the channel. Valve means 30 is preferably a mechanically or hydraulically operated valve that is opened to permit recirculation. Alternatively, an electromechanical solenoid valve which is normally biased in the open position can be used. When the valve 30 is open, oil recirculates to the inlet port 21. In systems where rotation of the gears is normal operation oil flows through channel 28 as the pump rotates during starter motor initiation of conventional crank mode. Valve means 30 is shown having spring 31 which biases hydraulic valve means 30 closed. Oil pressure or electrical means 32 such as a solenoid opens valve 30 to permit the recirculation of oil through channel 28. In an embodiment, vent 50 is useful to prevent any excess pressure in the pump seal bore 102 of a pump having restricted channel.

- In the presently preferred embodiment, the valve means 30 will be closed when outlet port 22 is open to permit oil to be pumped therethrough. Outlet port 22 may include an oil line to the engine to provide prelubrication as well known in the prior art or to a discharge receptacle, not shown, for changing the oil in the engine. A switch
- 5 positioned in the engine compartment can be used to simultaneously activate the turning of the starter motor (without engaging the starter solenoid) so that the closed valve means 30 permits the oil to be pumped out of the engine. Various other arrangements can be used to control valve means 30 with oil change and/or prelubrication flow control valves (not shown) positioned at the outlet port or line.
- 10 While presently preferred embodiments of the invention have been shown and described in particularity, the invention may be otherwise embodied within the scope of the appended claims.

**WHAT IS CLAIMED IS:**

1. An improved engine prelubrication pump assembly wherein the improvement comprises:
  - a. a pump housing having a pump cavity;
  - b. a first and second gear positioned in said cavity for pumping fluid, said first gear being operably and sealably connected to a motor shaft for rotation said shaft being positioned through a bore, and said second gear rotatably mounted to a second shaft for geared rotation with said first gear;
  - c. fluid inlet and outlet ports in communication with said cavity and adapted for connection with a source of fluid and a discharge means, respectively; and
  - d. an internal vent positioned between said motor shaft bore and said inlet port.
2. An improved engine prelubrication pump assembly as set forth in claim 1 wherein said first gear is operably connected to an independent motor.
3. An improved engine prelubrication pump assembly as set forth in claim 1 wherein said motor is a starter motor of a vehicle.
4. An improved engine prelubrication pump assembly as set forth in claim 3 wherein an armature of said starter motor comprises said means for rotating said first gear.
5. An improved engine prelubrication pump assembly as set forth in claim 4 wherein said vent is connected to said bore.
6. An improved engine prelubrication pump assembly further including a valve means positioned between said inlet and outlet ports, said valve means being controllable to permit fluid pumped between the inlet and outlet ports to pass through said valve means when said outlet port is flow restricted, said valve means being normally closed to fluid pumped by said first and second gears to flow from said inlet port to said outlet port, during prelubrication or

a fluid change, said valve means is opened to permit the oil to recirculate in response to a selective control input during operation of the pump when said prelubrication or fluid change is not selected.

7. An improved engine prelubrication pump assembly as set forth in claim 6 wherein said valve means is a hydraulic valve biased closed until a preselected pressure is established by a restriction in oil flow to the outlet port.

8. An improved engine prelubrication pump assembly as set forth in claim 6 further including a vent positioned into said pump housing along said inlet port.

9. An improved engine prelubrication pump assembly as set forth in claim 8 wherein said vent is connected to a motor shaft bore.

10. An improved engine prelubrication pump assembly as set forth in claim 6 further including a means to reduce the pressure in said pump assembly.

**AMENDED CLAIMS**

[received by the International Bureau on 28 February 2002 (28.02.02);  
original claims 1 and 6 amended; new claims 11-13 added;  
remaining claim unchanged (3 pages)]

1. An improved engine prelubrication pump assembly for use with an internal combustion engine motor wherein the improvement comprises:
  - a. a pump housing having a pump cavity;
  - b. a first and second gear positioned in said cavity for pumping fluid, said first gear being operably and sealably connected to a motor shaft for rotation said shaft being positioned through a bore, and said second gear rotatably mounted to a second shaft for geared rotation with said first gear;
  - c. fluid inlet and outlet ports in communication with said cavity and adapted for connection with a source of fluid and a discharge means, respectively; and
  - d. an internal vent positioned between said motor shaft bore and said inlet port.
2. An improved engine prelubrication pump assembly as set forth in claim 1 wherein said first gear is operably connected to an independent motor.
3. An improved engine prelubrication pump assembly as set forth in claim 1 wherein said motor is a starter motor of a vehicle.
4. An improved engine prelubrication pump assembly as set forth in claim 3 wherein an armature of said starter motor comprises said means for rotating said first gear.
5. An improved engine prelubrication pump assembly as set forth in claim 4 wherein said vent is connected to said bore.
6. An improved engine prelubrication pump assembly comprising a pump housing having a pump cavity, two entrained gears positioned in said cavity for pumping fluid and fluid inlet and outlet ports in combination with said cavity, said pump assembly further including a valve means positioned between said inlet and outlet ports, said valve

means being controllable to permit fluid pumped between the inlet and outlet ports to pass through said valve means when said outlet port is flow restricted, said valve means being normally closed to fluid pumped by said first and second gears to flow from said inlet port to said outlet port, during prelubrication or a fluid change, said valve means is opened to permit the oil to recirculate in response to a selective control input during operation of the pump when said prelubrication or fluid change is not selected.

7. An improved engine prelubrication pump assembly as set forth in claim 6 wherein said valve means is a hydraulic valve biased closed until a preselected pressure is established by a restriction in oil flow to the outlet port.

8. An improved engine prelubrication pump assembly as set forth in claim 6 further including a vent positioned into said pump housing along said inlet port.

9. An improved engine prelubrication pump assembly as set forth in claim 8 wherein said vent is connected to a motor shaft bore.

10. An improved engine prelubrication pump assembly as set forth in claim 6 further including a means to reduce the pressure in said pump assembly.

11. An improved engine prelubrication pump assembly as set forth in claim 1 further including a shaft seal which seals said pump cavity from said motor shaft.

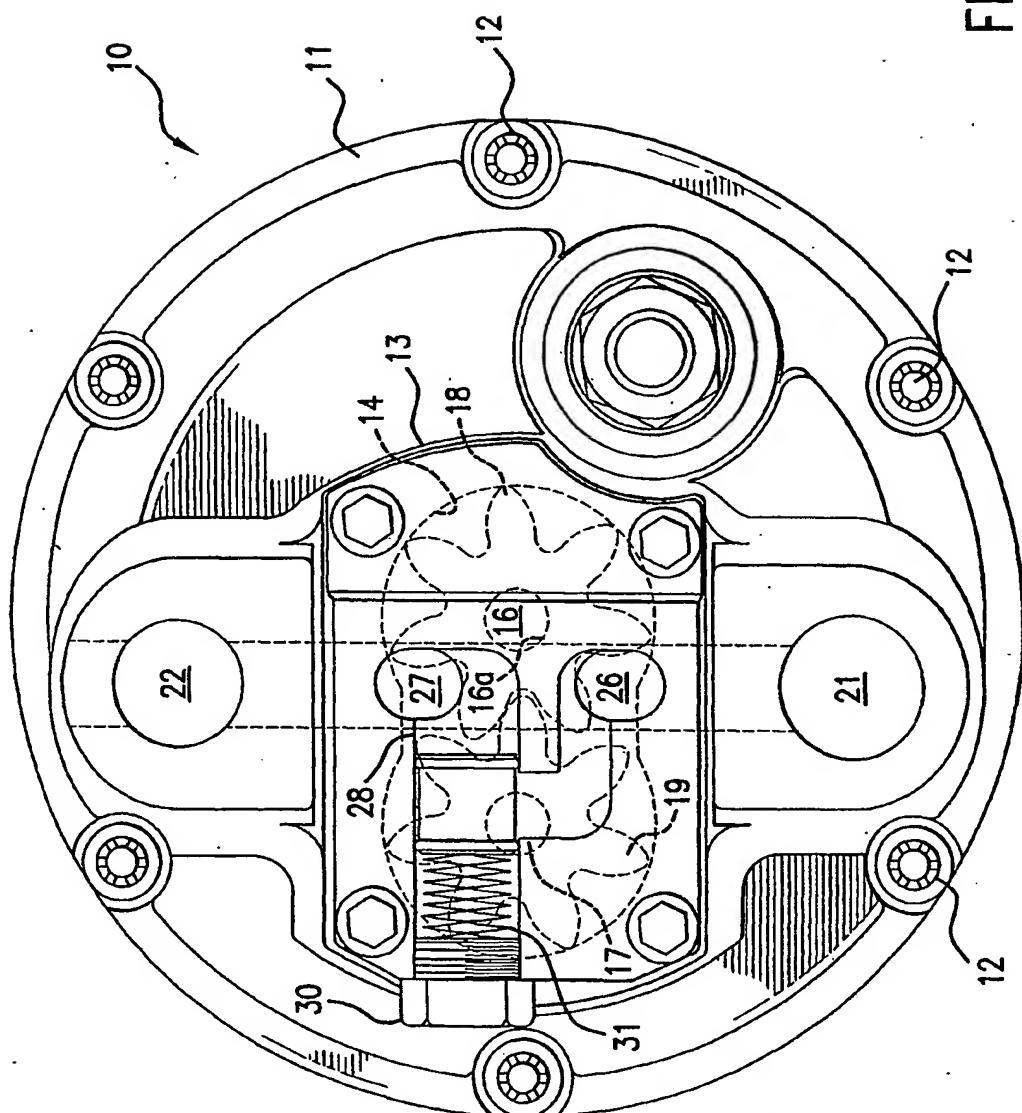
12. An improved engine prelubrication pump assembly as set forth in claim 11 wherein said vent connects said bore to said inlet port thereby decreasing the pressure in the area of said seal.

13. An improved engine prelubrication pump assembly as set forth in claim 1, further including a bypass means positioned between said inlet and outlet ports, said bypass

means being selectively controllable to permit fluid pumped between the inlet and outlet ports to pass through said bypass means, said bypass means being closed to fluid pumped by said first and second gears to flow from said inlet port to said outlet port, during a prelubrication or a fluid change, is opened to permit the oil to cavitate in response to a selective control input during operation of the pump when said prelubrication or fluid change is not selected.

1/4

FIG. 1



2/4

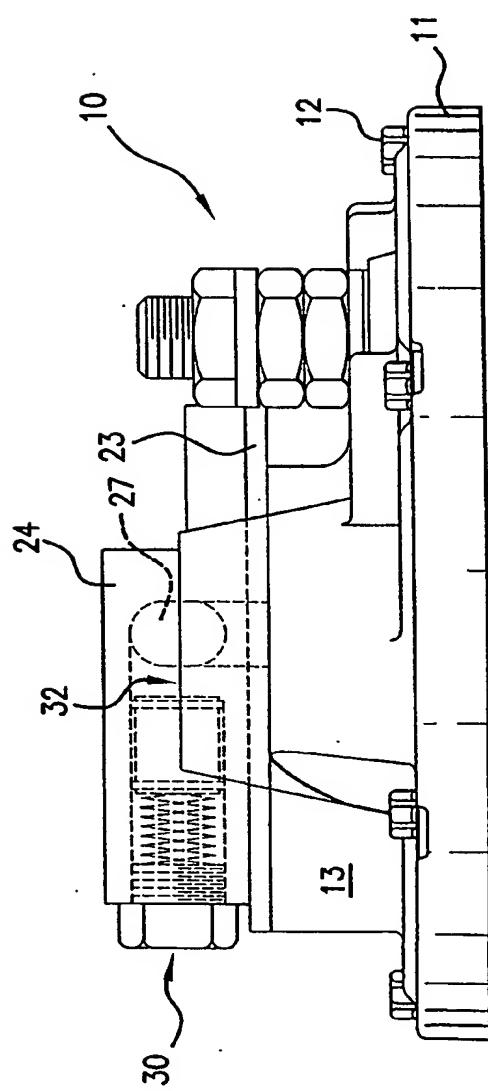
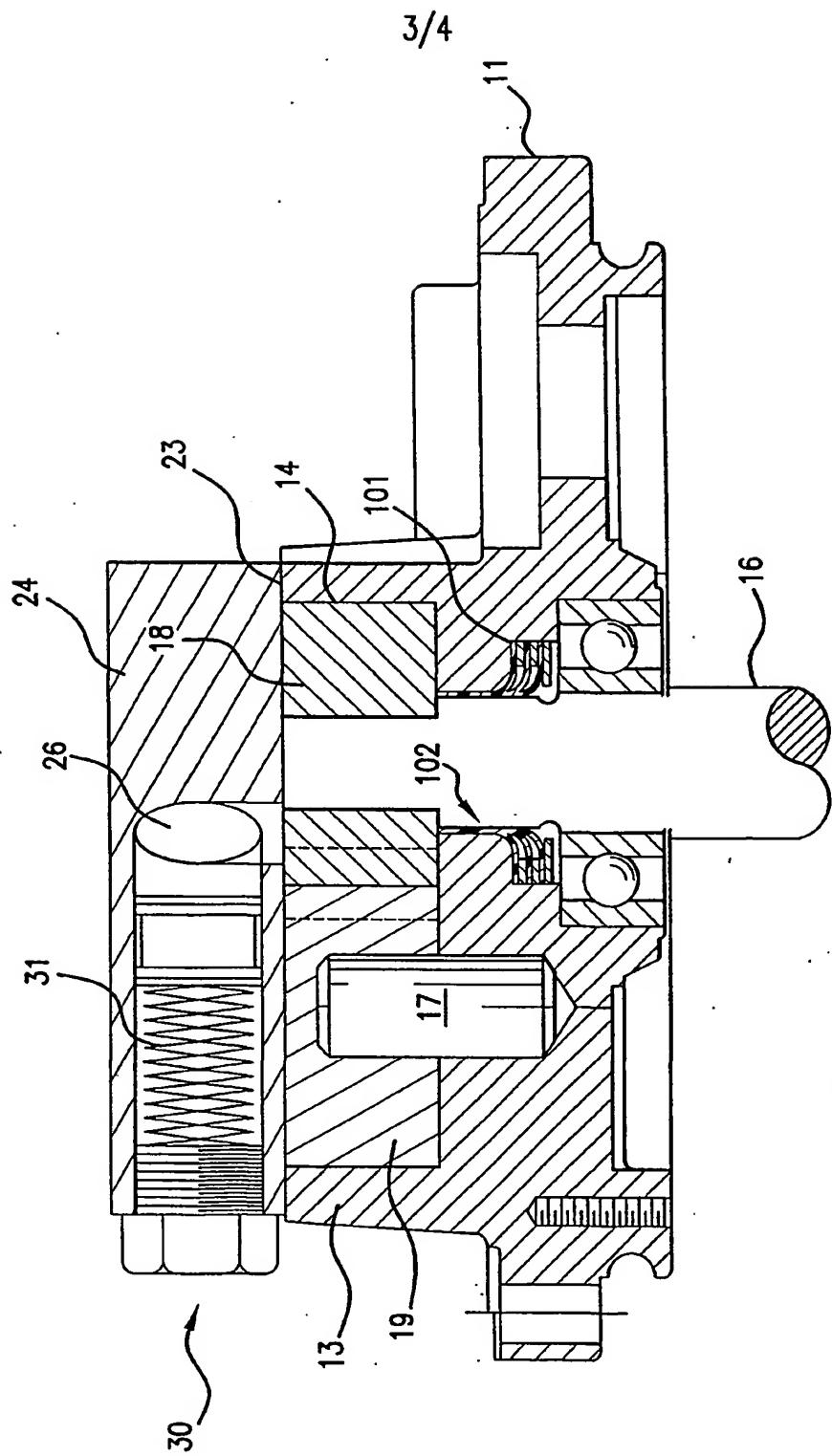
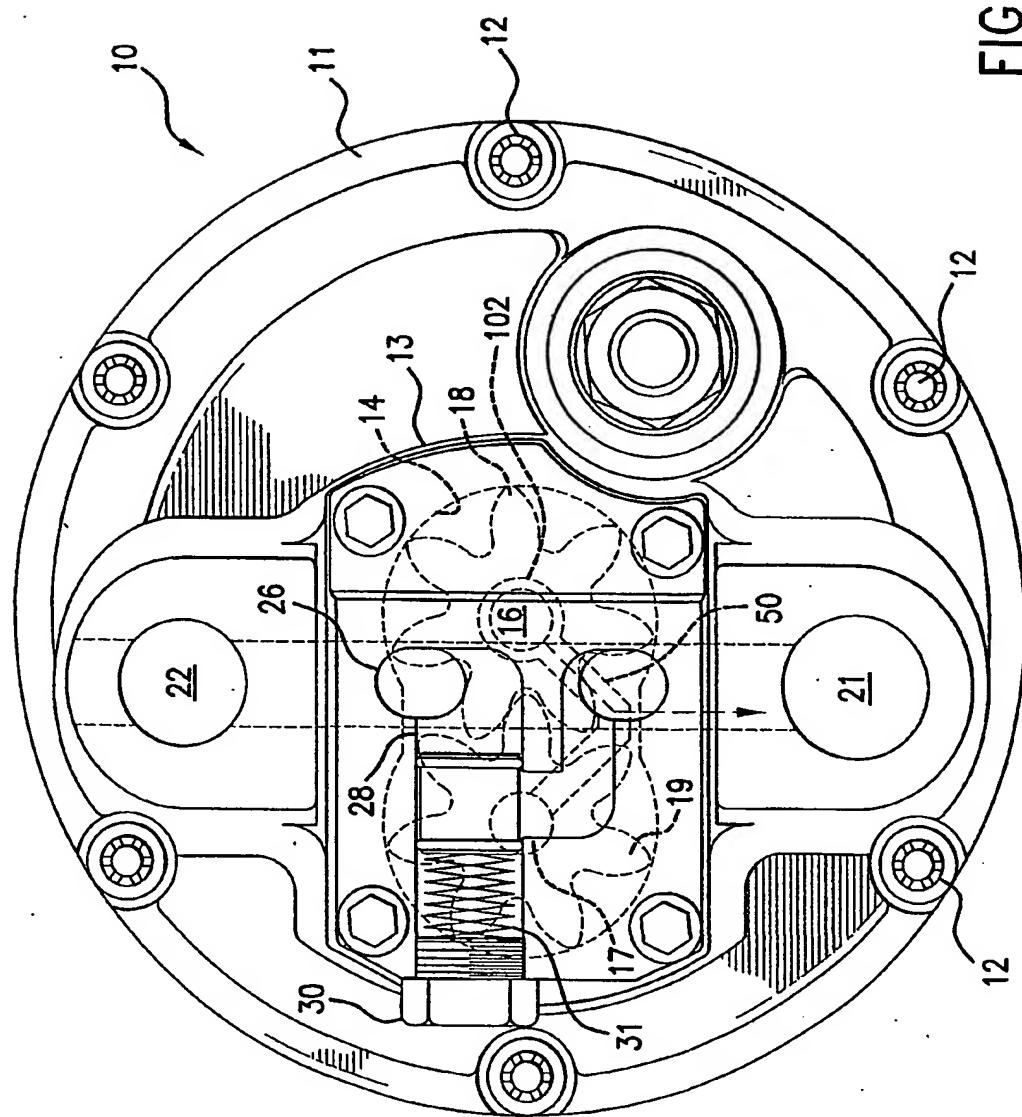


FIG.2



4/4

FIG.4



# INTERNATIONAL SEARCH REPORT

International application No.

PCT/US01/30281

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : F04B 49/00; F04C 19/00  
US CL : 417/310, 440; 418/104

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
U.S. : 417/310, 440; 418/104, 206

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
Please See Continuation Sheet

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4,290,739 A (KORSE) 22 September 1981 (22.09.1981), Figures 1, 2, 3.	1
Y		2-10
Y	US 4,553,512 A (SHOWMAN) 19 November 1985 (19.11.1985), column 2, line 65-column 3, line 6.	2-5
Y	US 2,887,058 A (ASPELIN et al) 19 May 1959 (19.05.1959), Figures 2-3.	6
Y	US 3,146,720 A (HENRY) 01 September 1964 (01.09.1964), see entire document.	6-10
Y	US 4,813,853 A (OTTO et al) 21 March 1989 (21.03.1989), see entire document.	6-10

<input type="checkbox"/>	Further documents are listed in the continuation of Box C.	<input type="checkbox"/>	See patent family annex.
--------------------------	------------------------------------------------------------	--------------------------	--------------------------

* Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier application or patent published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means		
"P" document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search  12 November 2001 (12.11.2001)	Date of mailing of the international search report  <b>31 DEC 2001</b>
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703)305-3230	Authorized officer  <i>J. Husley Jr.</i> Cheryl J. Tyler Telephone No. 703-308-0861

**INTERNATIONAL SEARCH REPORT**

International application No.

PCT/US01/30281

**Continuation of B. FIELDS SEARCHED Item 3:**

**EAST**

search terms: gear pump; vent; pressure reduction; motor; shaft; seal